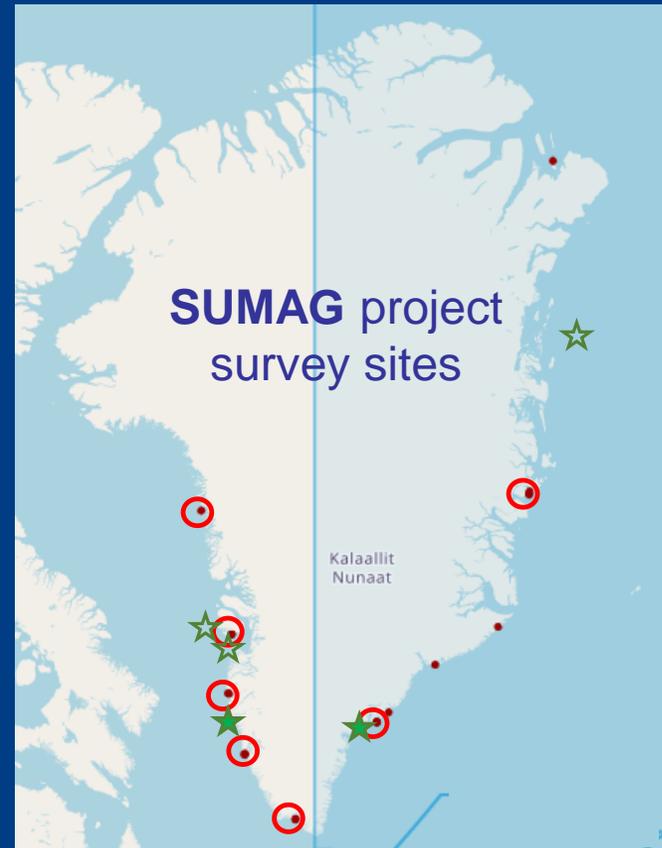


Trends and composition of plastic pollution in West and East Greenland 2016 - 2022



Jakob Strand



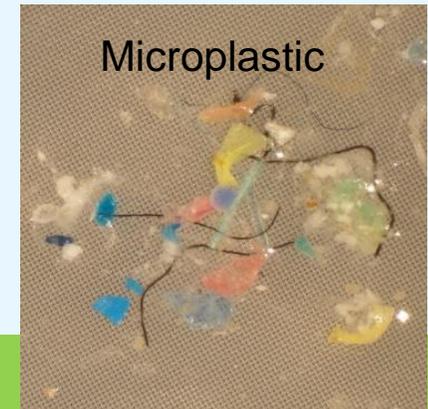
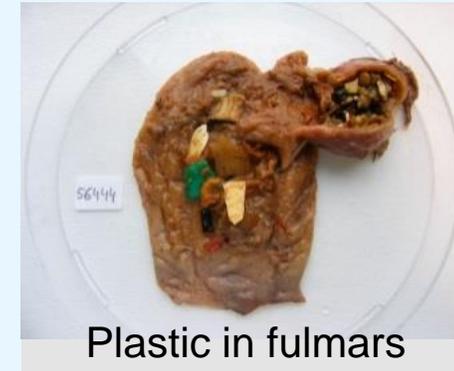
Marine litter indicators studied – as part of the SUMAG-project 2016-22

Focus on three recommended AMAP & OSPAR indicators for assessing amounts, composition and impacts of marine litter:

Indicator 1. **Shoreline litter**, 100 m surveys

Indicator 2. **Ingested plastic** in seabird stomachs

Indicator 3. **Microplastic** in sediments



AIMS:

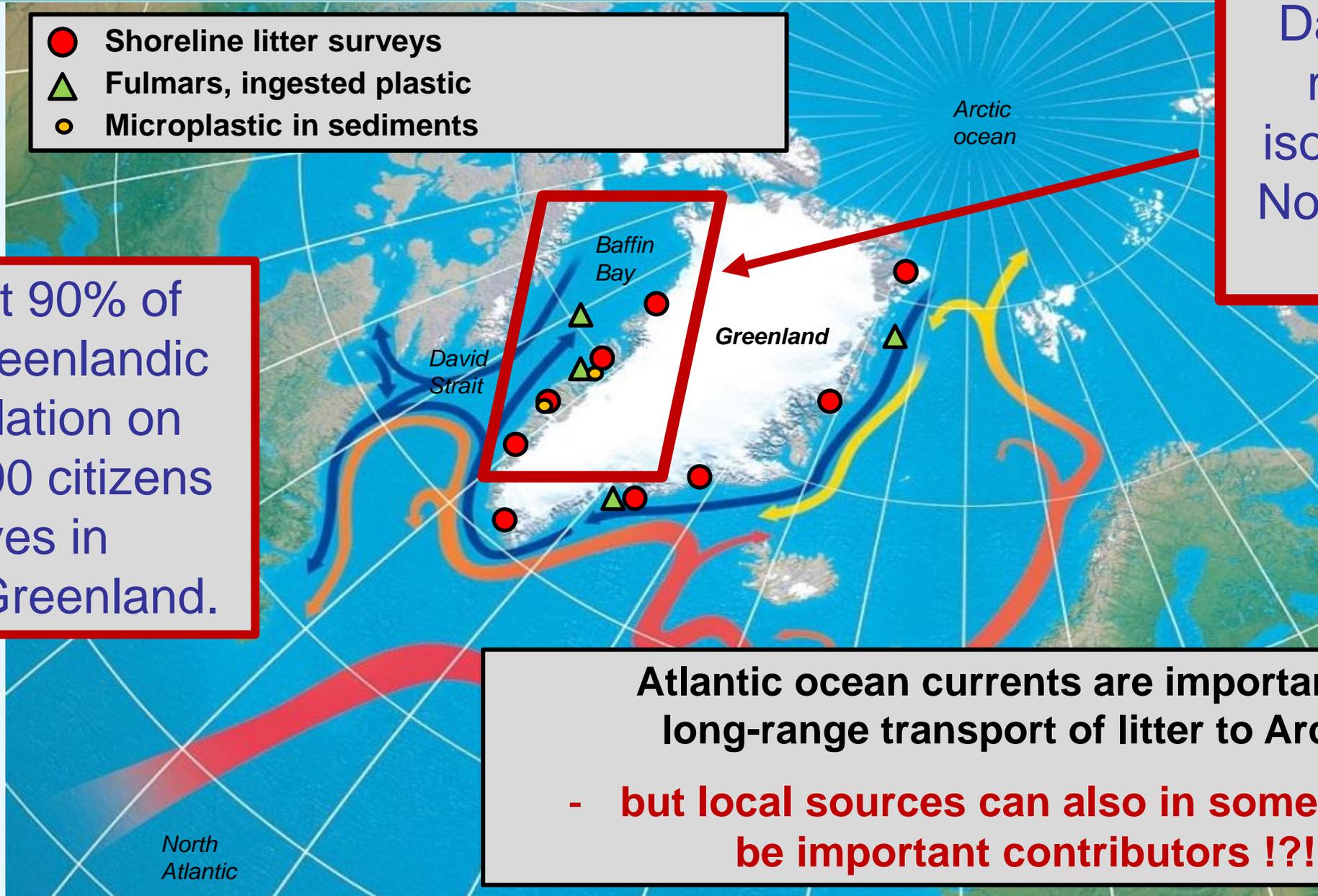
- to get experience with marine litter indicators relevant for Greenlandic environments.
- to establish a systematic data set, that can be used as first input for setting baseline levels for assessments of spatial and temporal trends,
and also for comparison with other North Atlantic and Arctic regions.
- to establish a local contact network in Greenland with capacity and interest in supporting such monitoring activities.
- to interact with stakeholders (e.g. EPAs, AMAP, OSPAR) and the public.

Study areas in Greenland 2016 - 2020

- Shoreline litter surveys
- ▲ Fulmars, ingested plastic
- Microplastic in sediments

Baffin Bay and Davis Strait relatively isolated from North Atlantic inputs.

About 90% of the Greenlandic population on ~56.000 citizens lives in West Greenland.



Atlantic ocean currents are important for long-range transport of litter to Arctic.

- but local sources can also in some regions be important contributors !?!

North Atlantic

Arctic ocean

Greenland

Baffin Bay

Davis Strait

Shoreline litter monitoring - Experiences and challenges

Monitoring strategy:

Conduction of continuous monitoring efforts mainly **with assistance from a local contact network.**

1 - 3 reference sites per area surveyed 1 - 2 times per year. All sites at some distance to towns.

National protocol with 203 litter item categories - converted into 127 categories **in OSPAR database**

QA/QC on data by survey coordinator incl. assessments of provided photo documentations.

Spatial trend assessments:

Multiple monitoring sites needed to reach minimum 40 surveys from sites that are repeatedly monitored year by year within a 3 – 6 years time period (OSPAR QSR23 recommendation),

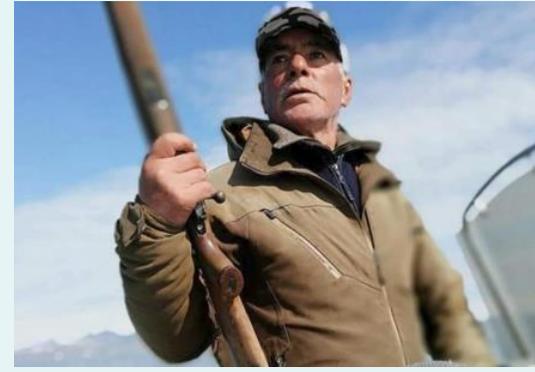
Aim: to determine robust national/(sub)regional median values for spatial trend assessments

Temporal trend assessments:

At least 4 - 5 years data with yearly monitoring on sites needed (OSPAR QSR recommendation)

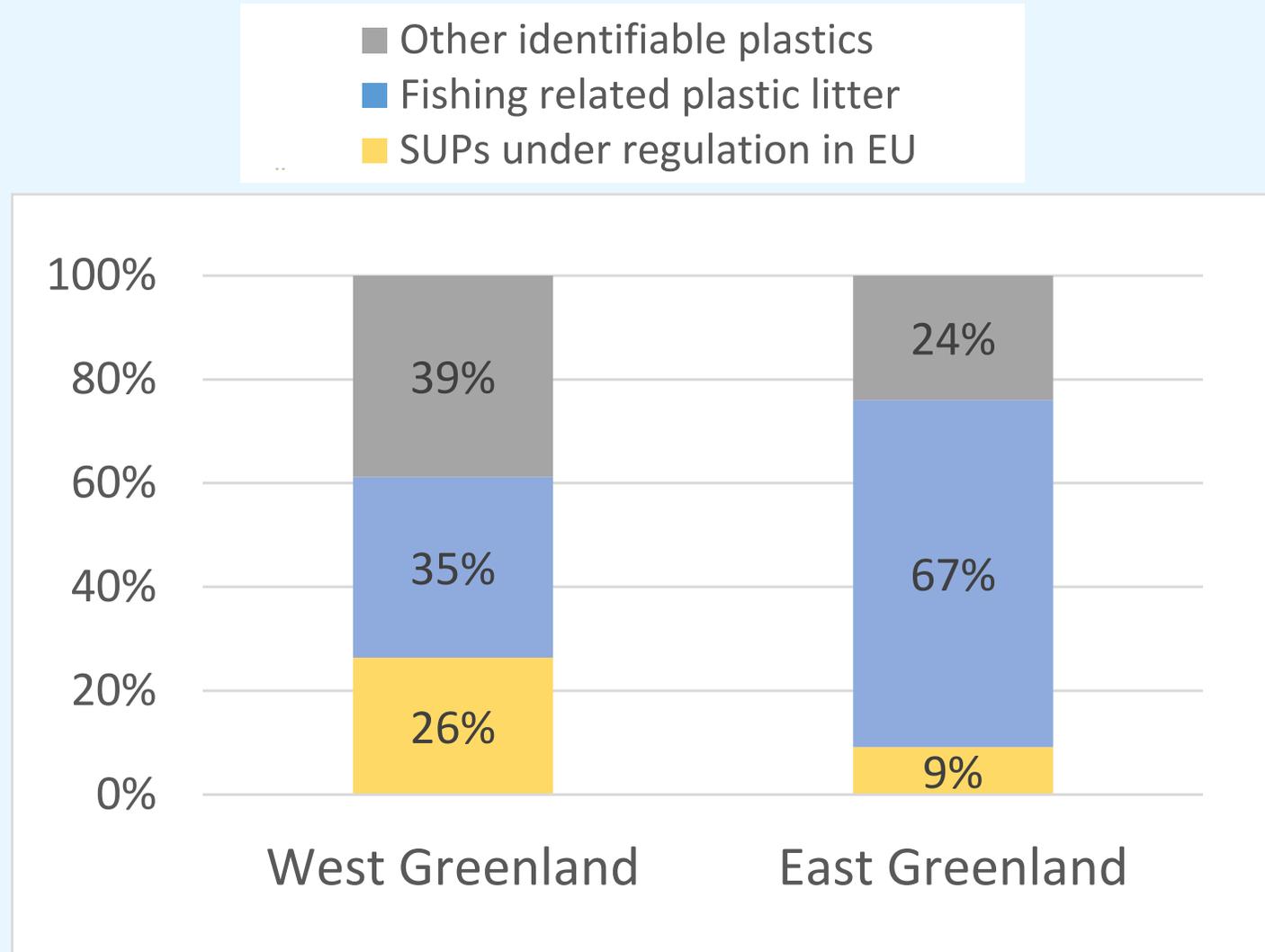


Solid experience with involving a local contact network conducting the surveys and sample collection at multiple sites



Thereby also benefitting from indigenous knowledge, when it comes to both logistic challenges and ID of some local types of litter items.

Relatively more **Single Use Plastics (SUP)** in West Greenland, - and more **SEA-based litter** in East Greenland



Unidentifiable fragments excluded

TOP 10 or 20 item lists → Relatively more **SUP items** in West Greenland

and more **SEA-based items** in East

WEST GrL

Among top 10
4 SUP items

and

1 sea-based
item

and

7 other
identifiable
user plastic
items

Top	WEST Greenland	EAST Greenland
1	[46] Plastic fragments <50cm	[46] Plastic fragments <50cm
2	[74] Machined wood <50cm	[74] Machined wood <50cm
3	[32] Strings (diameter < 1cm)	[32] Strings (diameter <1cm)
4	[43] Shotgun cartridges	[39] Strapping band
5	[45] Insulation foam sponges	[115] Net pieces <50 cm
6	[2] Plastic bags (e.g. shopping)	[74] Machined wood >50cm
7	[4] Plastic drink bottles	[116] Net pieces >50 cm
8	[15] Plastic caps/lids	[43] Shotgun cartridges
9	[19] Crisp/sweets packaging	[33] Tangled strings/nets
10	[39] Strapping band	[2] Plastic bags (e.g. shopping)
11	[74] Machined wood >50cm	[12] Other plastic bottles
12	[40] Industrial sheetings	[15] Plastic caps/lids
13	[1] Plastic yokes/wrap for bottles/cans	[113] Gloves professional
14	[3] Small plastic bags	[78] Metal drink cans
15	[5] Plastic cleaner bottles	[3] Small plastic bags
16	[6] Plastic food containers	[40] Industrial sheetings
17	[7] Plastic cosmetic bottles	[48] Other identifiable plastic items
18	[8] Engine oil containers <50cm	[1] Plastic yokes/wrap for bottles/cans
19	[10] Plastic Jerry cans	[4] Plastic drink bottles
20	[11] Injection gun containers	[6] Plastic food containers

EAST GrL

Among top 10
1 SUP item

and

4 sea-based
items

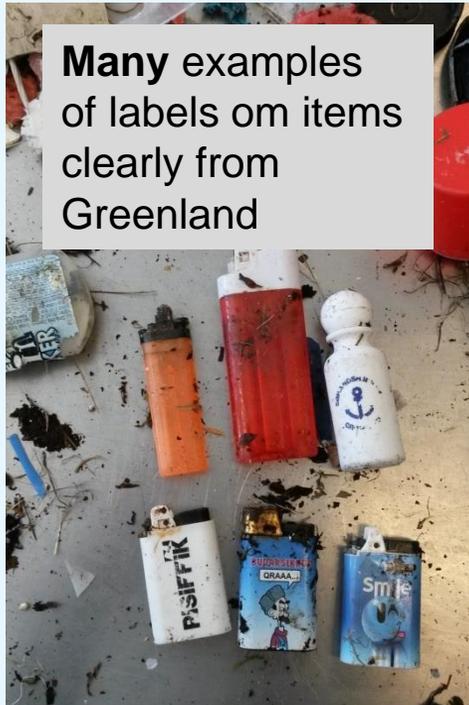
and

2 other
identifiable
user plastic
items

[OSPAR ID] SUP SEA Other plastics Other materials
Single Use Plastics Sea-based Plastics

List based on medians of medians

Importance of local land-based and sea-based sources



Local sources

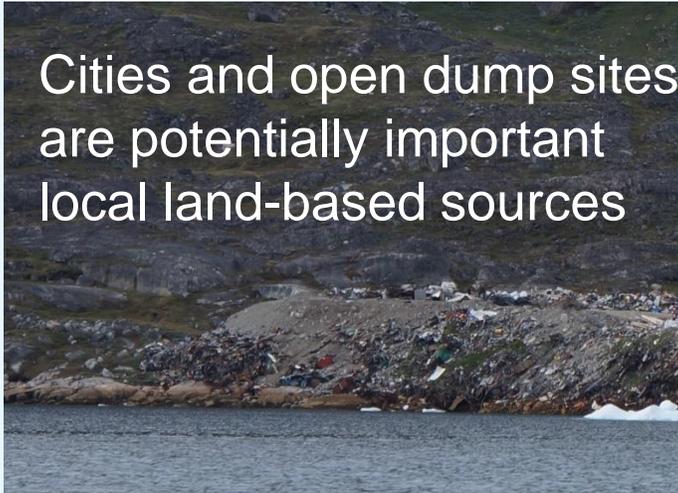
LAND-based and SEA-based

seem to dominate more in **West Greenland**

In **East Greenland,**

SEA-based sources dominate

and maybe also some inputs from **transboundary transport**



The implementation of improved national plastic and waste strategies in Greenland are ongoing

TREND assessment of shoreline litter monitoring in Greenland 2016 – 2022

Spatial assessments

>40 surveys achieved in West Greenland every 3 year, not in East

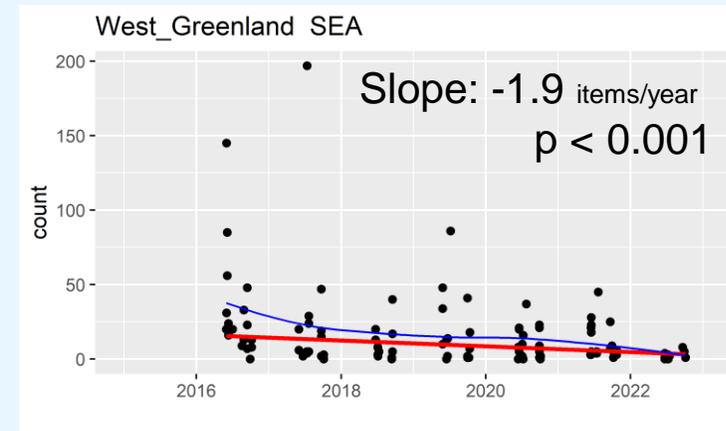
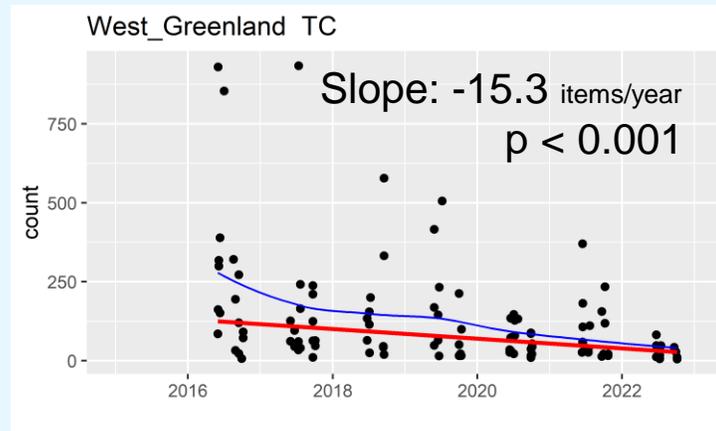


Able to derive robust national/(sub)regional median values

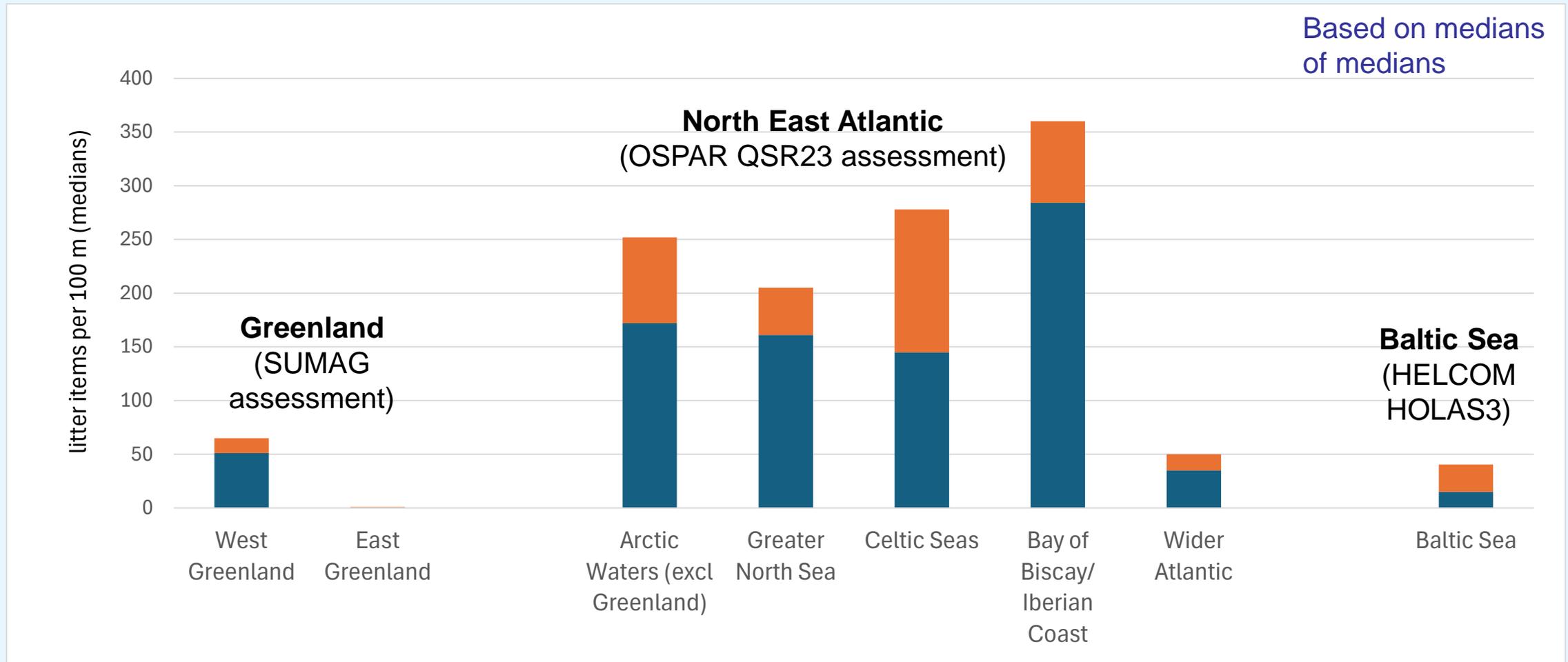
Survey areas (data per 100 m)	No. sites	No. surveys	Total records all years	Total counts, TC (median)	Plastic items (median)	SUP items (median)	SEA items (median)
Upernavik	1	4	1612	132	115	29	45
Qeqertarsuaq (Disko)	2	24	2453	53	29	4	2.5
Sisimiut	2	17	1388	35	30	6	5
Nuuk	3	36	2775	90	75	14	21
Qaqortoq	2	22	1954	65	53	7	8
Kulusuk/HenryL (East)	4	8	1188	104	93	8	28
Northeast Greenland	5	14	18	0	0	0	0
West Greenland (total)	10	103	10182	65	51	14	17
East Greenland (total)	9	22	1206	1	0	0	0

Temporal assessments

Based on non-parametric Theil-Sen slope statistics (as in OSPAR QSR23)



Comparison of shoreline litter data from Greenland 2016 - 2022 with similar data from North East Atlantic (OSPAR) and Baltic Sea (HELCOM)



The litter levels in West Greenland lower than most part of North East Atlantic - but higher than in Baltic Sea

Seabirds: Northern fulmars as indicator for ingestion of plastic

Study on plastic contents in fulmar stomachs according to OSPAR protocol and AMAP recommendations.



Examination of fulmars collected:

- West Greenland 2000, 2016, 2020
- North East Greenland 2017
- East Greenland 2022

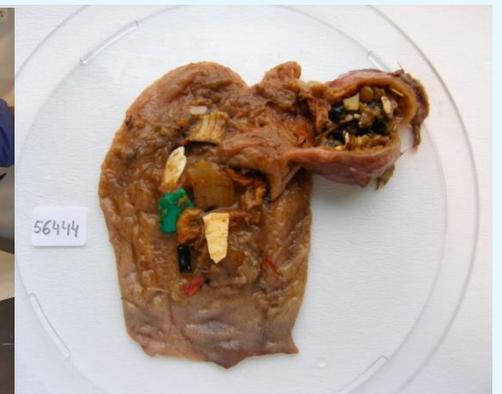
Research permission from Ministry of Fisheries and Hunting in Greenland

AMAP, 2021

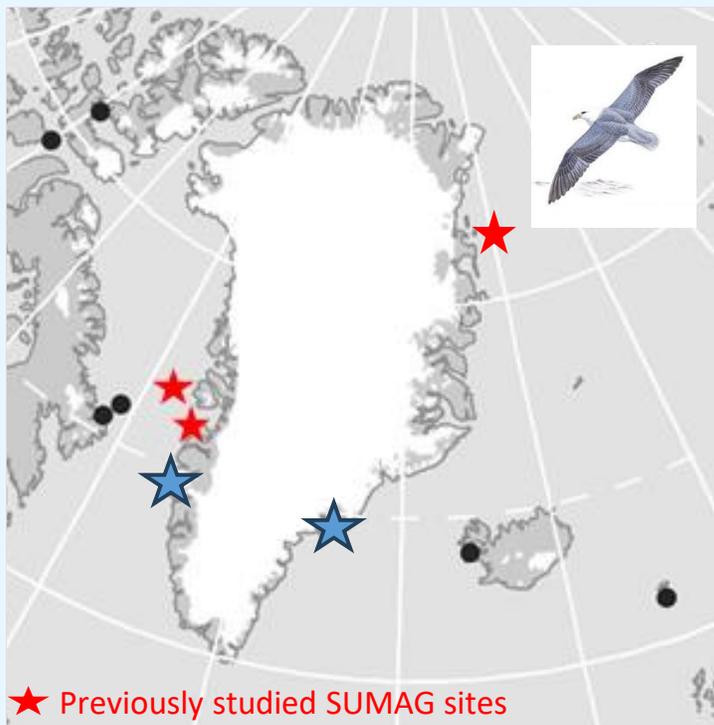
Mammals and birds can address several types of monitoring objective for litter and microplastics in Arctic ecosystems.



- Fulmars can be used to track spatial and temporal trends
- Thick-billed murre and common eiders should be considered for monitoring in relation to plastic pollution in food webs and trophic transfer
- Pinniped and polar bear scat may be used for food web monitoring targeting bigger plastics
- Seabird and marine mammal tissues should also be considered for monitoring of plastic additives and nanoplastic burdens
- Studies on mammals are important for addressing questions related to regional food security and safety



Fulmar results from two recent monitoring-oriented sampling campaigns in Coastal waters of West and East Greenland in 2020 and 2022



★ Previously studied SUMAG sites



EAST Greenland 2022 (n = 40)

- 100% contained at least one piece of plastic
- 72% of birds with >0.1 g plastic
- In average: 129 plastic particles (median 57)
- Maximum values: 1823 particles and 1.1 g in one bird

WEST Greenland 2020 (n = 40)

- 93% contained at least one piece of plastic
- 23% of the birds with >0.1 g plastic
- In average: 15 plastic particles (median 11)
- Maximum values: 61 particles and 0.30 g

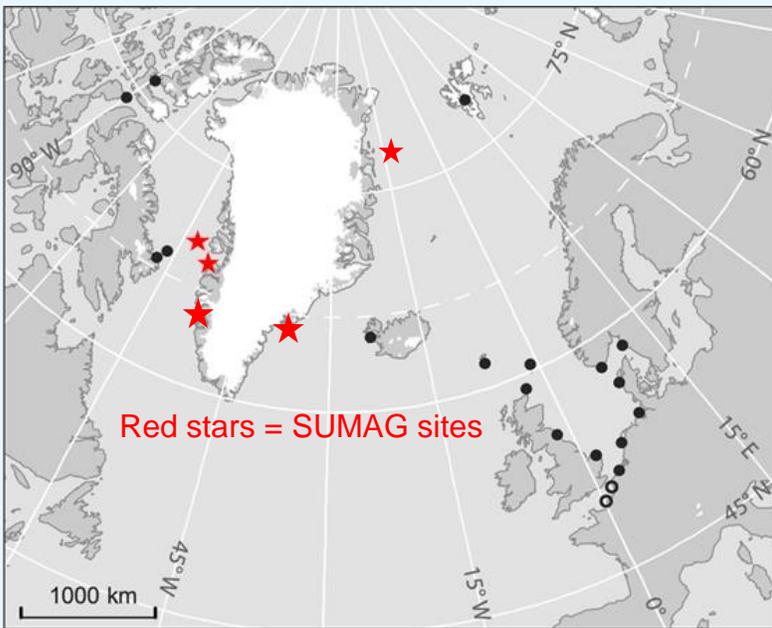


Almost all birds contained at least 1 piece of plastic

72% of the birds from East Greenland contained > 0.1 g plastic

→ *Thereby very high compared to EcoQO threshold value established to be only 10% of the birds with >0.1 g plastic.*



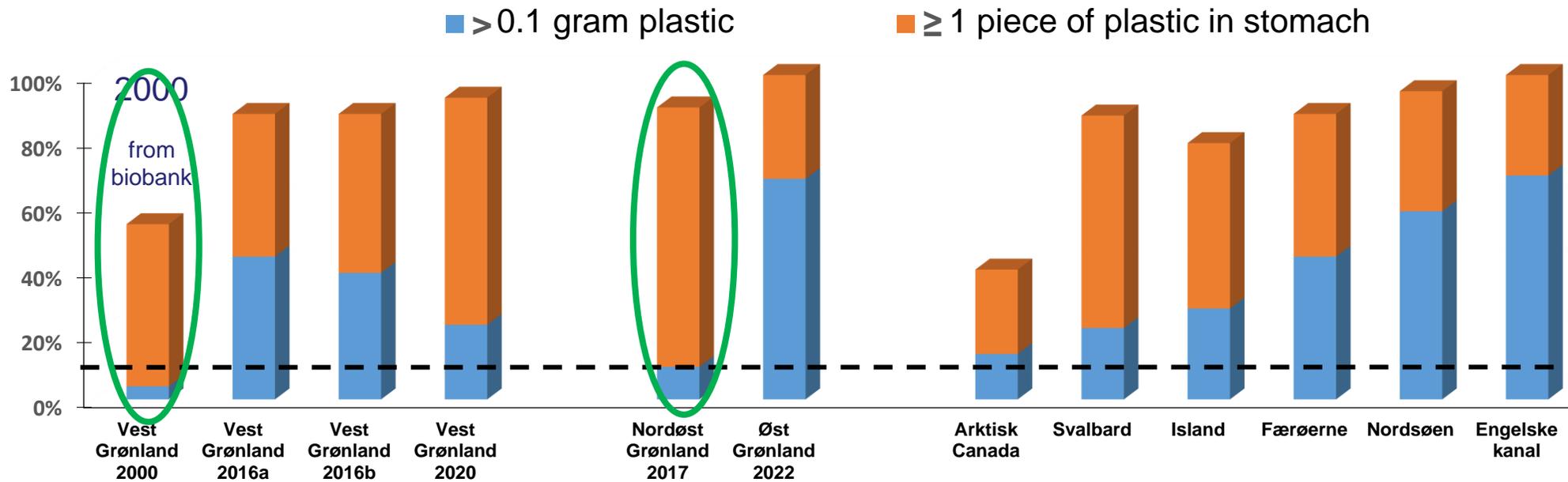


Plastic in northern fulmars

West Greenland 2016-2020: The levels are comparable with previously reports from Arctic Canada, Svalbard and Iceland, but lower than in the North Sea

East Greenland 2022: The level was surprisingly higher

North-East Greenland 2017: The level of plastic ingestion was lower - and even lower than OSPAR EcoQO.



**OSPAR and EU
 -- EcoQO --**

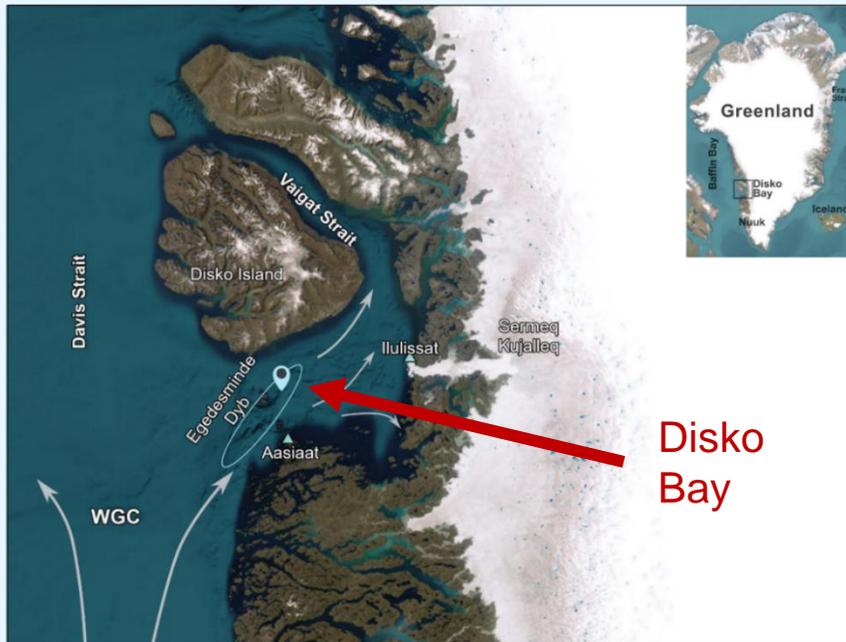
**< 10% birds
 with
 > 0.1g plastic**

(SUMAG-project)

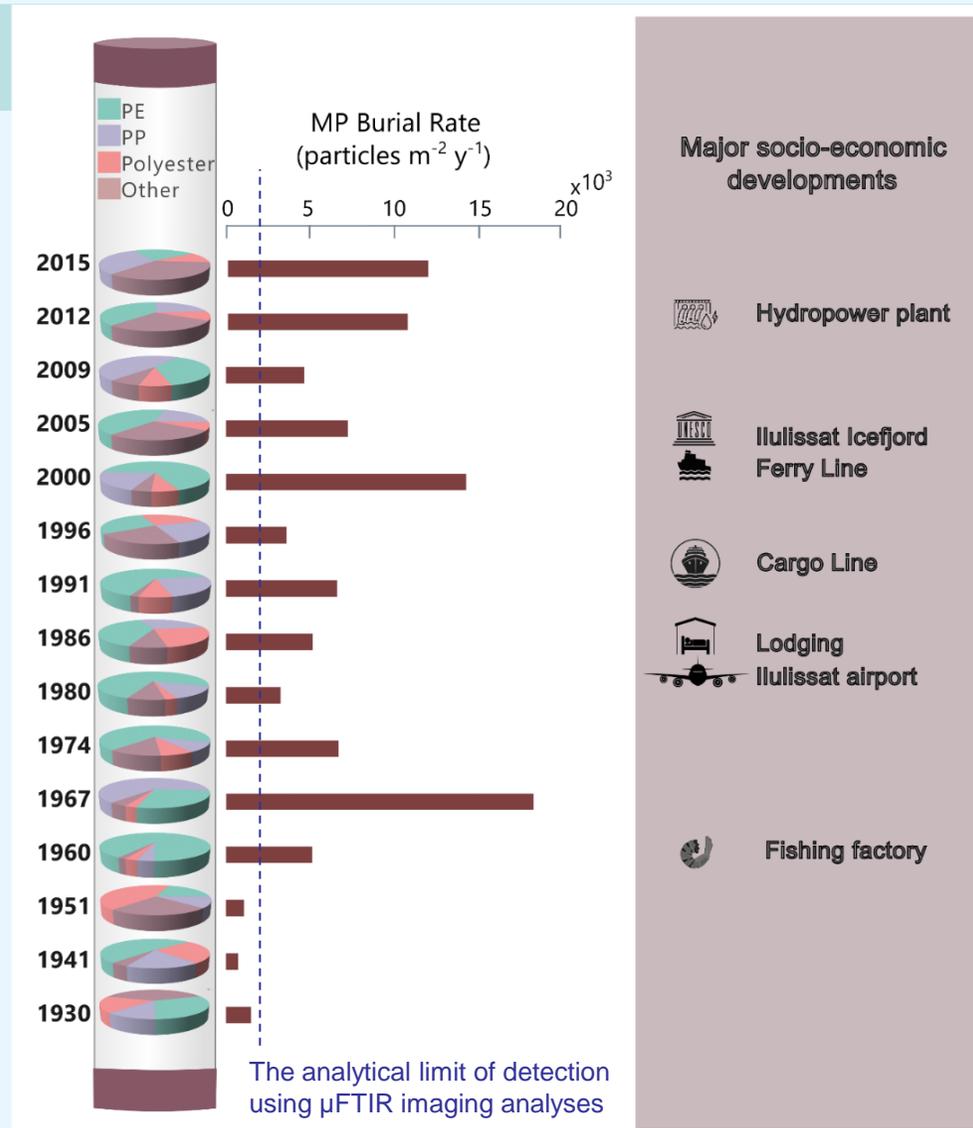
(Data and map from Trevail et al. 2015 and OSPAR)

Microplastic (MP) in sediments

Trends of MP (>20 μm)
in the antropocene period analysed
using a Pb²¹⁰ dated sediment core
from **Disko bay, West Greenland**



From
Parga Martinez et al. (in press)



The dominant plastic polymers:

- Polyethylene (PE)
- Polypropylene (PP)
- Polyester

MP accumulation increases significantly after 1950 along with major socio-economic development in the area

Take home messages

More litter occur on shorelines in West Greenland compared to in East Greenland.

**The litter originate from both sea- and land-based sources.
Transboundary transport seems only to be a minor contributor in West Greenland.**

Relatively high proportions of the seabird northern fulmar in West and East Greenland contain elevated amounts of plastic in their stomachs.

Microplastic particles from e.g. fragmentation of larger plastic debris are found in both seabirds and sediments.

The generated project data can be used as input for Greenlandic baseline levels for assessments of trends and effects of actions, nationally and regionally.

The SUMAG-project will continue to gather data on marine litter in Greenland.

Acknowledgement for support

Cooperation with:

- Greenland Institute for Natural Resources
- Copenhagen University
- Arctic researchers from UArctic and AMAP LMEG
- A local contact network in Greenland



Financial support from:

- The Danish EPA / Arktisk Miljøstøtte
- VELUX and Villum foundations
- Aarhus University an Arctic Research Centre